

A

## Preliminary Classification:

Proposed Class:

Subclass:

NOTE: "All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example "Proposed Class 2, subclass 129." M.P.E.P. § 601, 7th ed.

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application  
Assistant Commissioner for Patents  
Washington, D.C. 20231

## NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s): Tapio MANTYSAALO, Nina MUURINEN

WARNING: 37 C.F.R. § 1.41(a)(1) points out:

"(a) A patent is applied for in the name or names of the actual inventor or inventors.

"(1) The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by § 1.63, except as provided for in § 1.53(d)(4) and § 1.63(d). If an oath or declaration as prescribed by § 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to § 1.53(b), unless a petition under this paragraph accompanied by the fee set forth in § 1.17(f) is filed supplying or changing the name or names of the inventor or inventors."

For (title): MICROPHONE STRUCTURE

## CERTIFICATION UNDER 37 C.F.R. § 1.10\*

(Express Mail label number is mandatory.)

(Express Mail certification is optional.)

I hereby certify that this New Application Transmittal and the documents referred to as attached therein are being deposited with the United States Postal Service on this date 13 November 2000, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EL627420728US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Deborah J. Clark

(type or print name of person mailing paper)

Deborah J. Clark

Signature of person mailing paper

WARNING: Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

\*WARNING: Each paper or fee filed by "Express Mail" must have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).

"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will not be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

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J0688 U.S. PTO

09/11/15

11/13/00

J0615 U.S. PTO

11/13/00

## 1. Type of Application

This new application is for a(n)

(check one applicable item below)

☒ Original (nonprovisional)

☐ Design

☐ Plant

**WARNING:** Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. § 371(c)(4), unless the International Application is being filed as a divisional, continuation or continuation-in-part application.

**WARNING:** Do not use this transmittal for the filing of a provisional application.

**NOTE:** If one of the following 3 items apply, then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION.

☐ Divisional.

☐ Continuation.

☐ Continuation-in-part (C-I-P).

## 2. Benefit of Prior U.S. Application(s) (35 U.S.C. §§ 119(e), 120, or 121)

**NOTE:** A nonprovisional application may claim an invention disclosed in one or more prior filed copending nonprovisional applications or copending international applications designating the United States of America. In order for a nonprovisional application to claim the benefit of a prior filed copending nonprovisional application or copending international application designating the United States of America, each prior application must name as an inventor at least one inventor named in the later filed nonprovisional application and disclose the named inventor's invention claimed in at least one claim of the later filed nonprovisional application in the manner provided by the first paragraph of 35 U.S.C. § 112. Each prior application must also be:

(i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or

(ii) Complete as set forth in § 1.51(b); or

(iii) Entitled to a filing date as set forth in § 1.53(b) or § 1.53(d) and include the basic filing fee set forth in § 1.16; or

(iv) Entitled to a filing date as set forth in § 1.53(b) and have paid therein the processing and retention fee set forth in § 1.21(f) within the time period set forth in § 1.53(f).

37 C.F.R. § 1.78(a)(1).

**NOTE:** If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an international application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

**WARNING:** If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. §§ 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. §§ 120, 121 or 365(c). (35 U.S.C. § 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. §§ 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.

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**WARNING:** When the last day of pendency of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, any nonprovisional application claiming benefit of the provisional application must be filed prior to the Saturday, Sunday, or Federal holiday within the District of Columbia. See 37 C.F.R. § 1.78(a)(3).

- ☐ The new application being transmitted claims the benefit of prior U.S. application(s). Enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

**3. Papers Enclosed**

**A.** Required for filing date under 37 C.F.R. § 1.53(b) (Regular) or 37 C.F.R. § 1.153 (Design) Application

7 Pages of specification

2 Pages of claims

4 Sheets of drawing

**WARNING:** DO NOT submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. For comments on proposed then-new 37 C.F.R. § 1.84, see Notice of March 9, 1988 (1990 O.G. 57-62).

**NOTE:** "Identifying Indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page . . . " 37 C.F.R. § 1.84(c).

(complete the following, if applicable)

- ☐ The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)." 37 C.F.R. § 1.84(b).

☐ formal

☐ informal

**B. Other Papers Enclosed**

       Pages of declaration and power of attorney

1 Pages of abstract

       Other

**4. Additional papers enclosed**

☐ Amendment to claims

☐ Cancel in this applications claims \_\_\_\_\_ before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)

☐ Add the claims shown on the attached amendment. (Claims added have been numbered consecutively following the highest numbered original claims.)

☒ Preliminary Amendment

☐ Information Disclosure Statement (37 C.F.R. § 1.98)

☐ Form PTO-1449 (PTO/SB/08A and 08B)

☐ Citations

- ☐ Declaration of Biological Deposit
- ☐ Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.
- ☐ Authorization of Attorney(s) to Accept and Follow Instructions from Representative
- ☐ Special Comments
- ☐ Other

**5. Declaration or oath (including power of attorney)**

**NOTE:** A newly executed declaration is not required in a continuation or divisional application provided that the prior nonprovisional application contained a declaration as required, the application being filed is by all or fewer than all the inventors named in the prior application, there is no new matter in the application being filed, and a copy of the executed declaration filed in the prior application (showing the signature or an indication thereon that it was signed) is submitted. The copy must be accompanied by a statement requesting deletion of the names of person(s) who are not inventors of the application being filed. If the declaration in the prior application was filed under § 1.47, then a copy of that declaration must be filed accompanied by a copy of the decision granting § 1.47 status or, if a nonsigning person under § 1.47 has subsequently joined in a prior application, then a copy of the subsequently executed declaration must be filed. See 37 C.F.R. §§ 1.63(d)(1)-(3).

**NOTE:** A declaration filed to complete an application must be executed, identify the specification to which it is directed, identify each inventor by full name including family name and at least one given name, without abbreviation together with any other given name or initial, and the residence, post office address and country or citizenship of each inventor, and state whether the inventor is a sole or joint inventor. 37 C.F.R. § 1.63(e)(1)-(4).

- ☐ Enclosed
- Executed by

(check all applicable boxes)

- ☐ Inventor(s).
- ☐ legal representative of inventor(s).  
37 C.F.R. §§ 1.42 or 1.43.
- ☐ Joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.
  - ☐ This is the petition required by 37 C.F.R. § 1.47 and the statement required by 37 C.F.R. § 1.47 is also attached. See item 13 below for fee.

- ☒ Not Enclosed.

**NOTE:** Where the filing is a completion in the U.S. of an International Application or where the completion of the U.S. application contains subject matter in addition to the International Application, the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

- ☒ Application is made by a person authorized under 37 C.F.R. § 1.41(c) on behalf of all the above named inventor(s).

(The declaration or oath, along with the surcharge required by 37 C.F.R. § 1.16(e) can be filed subsequently).

- ☐ Showing that the filing is authorized.  
(not required unless called into question. 37 C.F.R. § 1.41(d))

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## 6. Inventorship Statement

**WARNING:** If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted.

The inventorship for all the claims in this application are:

☐ The same.

or

☐ Not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

☐ is submitted.

☐ will be submitted.

## 7. Language

**NOTE:** An application including a signed oath or declaration may be filed in a language other than English. An English translation of the non-English language application and the processing fee of \$130.00 required by 37 C.F.R. § 1.17(h) is required to be filed with the application, or within such time as may be set by the Office. 37 C.F.R. § 1.52(d).

☒ English

☐ Non-English

☐ The attached translation includes a statement that the translation is accurate. 37 C.F.R. § 1.52(d).

## 8. Assignment

☒ An assignment of the invention to Nokia Mobile Phones Ltd.

☐ is attached. A separate ☐ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

☒ will follow.

**NOTE:** "If an assignment is submitted with a new application, send two separate letters—one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).

**WARNING:** A newly executed "CERTIFICATE UNDER 37 C.F.R. § 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.

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**9. Certified Copy**

Certified copy(ies) of application(s)

Country Finland	Appin. No. 20001327	2 June 2000	Filed
Country Finland	Appin. No. 20000569	10 March 2000	Filed
Country	Appin. No.		Filed

from which priority is claimed

☐ is (are) attached.☒ will follow.

NOTE: The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37 C.F.R. § 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. § 120 is itself entitled to priority from a prior foreign application, then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

**10. Fee Calculation (37 C.F.R. § 1.16)**A. ☒ Regular application

CLAIMS AS FILED				
Number filed		Number Extra	Rate	Basic Fee 37 C.F.R. § 1.16(a) \$ 710.00
Total Claims (37 C.F.R. § 1.16(c))	14 - 20 =	0	×	\$ 18.00
Independent Claims (37 C.F.R. § 1.16(b))	1 - 3 =	0	×	\$ 80.00
Multiple dependent claim(s), If any (37 C.F.R. § 1.16(d))			+	\$ 270.00

☐ Amendment cancelling extra claims is enclosed.☒ Amendment deleting multiple-dependencies is enclosed.☐ Fee for extra claims is not being paid at this time.

NOTE: If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 C.F.R. § 1.16(d).

Filing Fee Calculation \$ 710.00

B. ☐ Design application  
(\$ 320.00 - 37 C.F.R. § 1.16(f))

Filing Fee Calculation \$

C. ☐ Plant application  
(\$ 490.00 - 37 C.F.R. § 1.16(g))

Filing fee calculation \$

11. Small Entity Statement(s)

- ☐ Statement(s) that this is a filing by a small entity under 37 C.F.R. § 1.9 and 1.27 is (are) attached.

**WARNING:** "Status as a small entity must be specifically established in each application or patent in which the status is available and desired. Status as a small entity in one application or patent does not affect any other application or patent, including applications or patents which are directly or indirectly dependent upon the application or patent in which the status has been established. The re filing of an application under § 1.53 as a continuation, division, or continuation-in-part (including a continued prosecution application under § 1.53(d)), or the filing of a reissue application requires a new determination as to continued entitlement to small entity status for the continuing or reissue application. A nonprovisional application claiming benefit under 35 U.S.C. § 119(e), 120, 121, or 365(c) of a prior application, or a reissue application may rely on a statement filed in the prior application or in the patent if the nonprovisional application or the reissue application includes a reference to the statement in the prior application or in the patent or includes a copy of the statement in the prior application or in the patent and status as a small entity is still proper and desired. The payment of the small entity basic statutory filing fee will be treated as such a reference for purposes of this section." 37 C.F.R. § 1.28(a)(2).

**WARNING:** "Small entity status must not be established when the person or persons signing the . . . statement can unequivocally make the required self-certification." M.P.E.P., § 509.03, 6th ed., rev. 2, July 1996 (emphasis added).

(complete the following, if applicable)

- ☐ Status as a small entity was claimed in prior application \_\_\_\_\_ / \_\_\_\_\_, filed on \_\_\_\_\_, from which benefit is being claimed for this application under:

35 U.S.C. § ☐ 119(e),  
☐ 120,  
☐ 121,  
☐ 365(c),

and which status as a small entity is still proper and desired.

- ☐ A copy of the statement in the prior application is included.

Filing Fee Calculation (50% of A, B or C above)

\$ \_\_\_\_\_

**NOTE:** Any excess of the full fee paid will be refunded if small entity status is established and a refund request are filed within 2 months of the date of timely payment of a full fee. The two-month period is not extendable under § 1.136. 37 C.F.R. § 1.28(a).

12. Request for International-Type Search (37 C.F.R. § 1.104(d))

(complete, if applicable)

- ☐ Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made at This Time

☐ Not Enclosed

- ☐ No filing fee is to be paid at this time.  
(This and the surcharge required by 37 C.F.R. § 1.16(e) can be paid subsequently.)

☒ Enclosed

- ☒ Filing fee \$ 710.00
- ☐ Recording assignment  
(\$40.00; 37 C.F.R. § 1.21(h))  
(See attached "COVER SHEET FOR  
ASSIGNMENT ACCOMPANYING NEW  
APPLICATION") \$ \_\_\_\_\_
- ☐ Petition fee for filing by other than all the  
inventors or person on behalf of the inventor  
where inventor refused to sign or cannot be  
reached  
(\$130.00; 37 C.F.R. §§ 1.47 and 1.17(l)) \$ \_\_\_\_\_
- ☐ For processing an application with a  
specification in  
a non-English language  
(\$130.00; 37 C.F.R. §§ 1.52(d) and 1.17(k)) \$ \_\_\_\_\_
- ☐ Processing and retention fee  
(\$130.00; 37 C.F.R. §§ 1.53(d) and 1.21(l)) \$ \_\_\_\_\_
- ☐ Fee for international-type search report  
(\$40.00; 37 C.F.R. § 1.21(e)) \$ \_\_\_\_\_

NOTE: 37 C.F.R. § 1.21(f) establishes a fee for processing and retaining any application that is abandoned for failing to complete the application pursuant to 37 C.F.R. § 1.53(f) and this, as well as the changes to 37 C.F.R. §§ 1.53 and 1.76(a)(1), indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid, or the processing and retention fee of § 1.21(f) must be paid, within 1 year from notification under § 53(f).

Total fees enclosed \$ 710.00

14. Method of Payment of Fees

- ☒ Check in the amount of \$ 710.00
- ☐ Charge Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_

A duplicate of this transmittal is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 C.F.R. § 1.22(b).

**15. Authorization to Charge Additional Fees**

**WARNING:** If no fees are to be paid on filing, the following items should not be completed.

**WARNING:** Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

- ☒ The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 16-1350.

☒ 37 C.F.R. § 1.16(a), (f) or (g) (filing fees)

☒ 37 C.F.R. § 1.16(b), (c) and (d) (presentation of extra claims)

**NOTE:** Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

☒ 37 C.F.R. § 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

☒ 37 C.F.R. § 1.17(a)(1)-(5) (extension fees pursuant to § 1.136(a)).

☒ 37 C.F.R. § 1.17 (application processing fees)

**NOTE:** "... A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

☐ 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

**NOTE:** Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

**NOTE:** 37 C.F.R. § 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . . the issue fee. . . ." From the wording of 37 C.F.R. § 1.28(b), (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

**16. Instructions as to Overpayment**

*NOTE: "... Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).*

- ☒ Credit Account No. 16-1350  
☐ Refund

**SEND ALL CORRESPONDENCE TO:**

Clarence A. Green, Reg. No.: 24,622  
PERMAN & GREEN, LLP  
425 Post Road  
Fairfield, Connecticut 06430

Reg. No. 24,622

Tel. No. ( 203 ) 259-1800

Customer No. 2512

  
\_\_\_\_\_  
SIGNATURE OF PRACTITIONER/

Clarence A. Green  
(type or print name of attorney)

PERMAN & GREEN, LLP

P.O. Address

425 Post Road, Fairfield, Connecticut 06430

☐ Incorporation by reference of added pages

*(check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an International application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED)*

- ☐ Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed

Number of pages added \_\_\_\_\_

- ☐ Plus Added Pages for Papers Referred to in Item 4 Above

Number of pages added \_\_\_\_\_

- ☐ Plus added pages deleting names of inventor(s) named in prior application(s) who is/are no longer inventor(s) of the subject matter claimed in this application.

Number of pages added \_\_\_\_\_

- ☐ Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added \_\_\_\_\_

☒ Statement Where No Further Pages Added

*(if no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item)*

- ☒ This transmittal ends with this page.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Express Mail No.: EL627420728US

In re Application of: MANTYSALO et al.

SERIAL NUMBER:

EXAMINER:

FILING DATE: Herewith

ART UNIT:

TITLE: MICROPHONE STRUCTURE

ATTORNEY DOCKET NO.: 413-009920-US(PAR)

The Commissioner of Patents and Trademarks

Washington, D.C. 20231

**PRELIMINARY AMENDMENT**

Dear Sir:

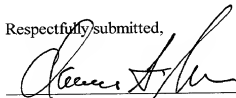
Please amend the above-identified, enclosed patent application as follows:

**IN THE CLAIMS:**

Please amend Claim 8 as shown below.

Claim 8, line 1, delete "claims 2 and 4" and insert --claim 2--.

Respectfully submitted,



Clarence A. Green, Reg. No. 24,622

Perman & Green, LLP

425 Post Road

Fairfield, CT 06430

(203) 259-1800

Customer No.: 2512

13 Nov 2000

Date

## Microphone structure

The invention relates in general to microphones. In particular the invention relates to microphones in mobile phones and their accessories.

- 5 There is a general need to protect microphones against radio frequency (RF) disturbances for ensuring the proper performance of the microphones. Microphone of mobile phone or mobile phone accessory should furthermore be immune to RF disturbances at the frequencies the cellular system uses. Consider for example a headset accessory of a mobile phone. It has a small earpiece connected to the
- 10 mobile phone with a wire and the microphone of the headset mounted on a stiff wire at suitable distance from the earpiece so that the microphone can pick up the voice of the user. The user may carry the mobile phone in a pocket during a call. If the user carries the mobile phone in a breast pocket of a shirt or a jacket, the microphone of a headset is very near the radio transmitter of the mobile phone. If
- 15 the microphone is not adequately protected, it can demodulate the radio frequency signal, in which case the quality of audio signal may deteriorate. Furthermore, there is need to protect microphones against electro-static discharge (ESD).

- Electret microphone is general type of microphones used in mobile phones and accessories. An electret microphone contains a preamplifier, typically a field effect transistor (FET), and voice is converted to electrical signal by capacitance. Changes
- 20 in the air pressure cause changes to the capacitance between a conductive plate and a conductive polarized foil. The conductive plate, the conductive foil, FET and other microphone parts, which are typically capacitors, are typically placed in side a microphone capsule. This capsule has typically two output contacts with which it is
- 25 connected to external circuitry.

- Electret microphones are protected against RF disturbances and ESD in various ways. Figure 1 shows an example of a prior-art protection circuit. The circuit relates to a headset accessory of a mobile phone. In the Figure there can be seen a microphone capsule 100, first protection circuit 110, a transmission line 120
- 30 between the headset accessory and mobile device, second protection circuit 130 and microphone amplifier 140. The microphone capsule contains an electret microphone M1 comprising FET Q1, which functions as preamplifier. The drain of FET is connected to first output contact OC1 of microphone capsule and the drain of FET is connected to second output contact OC2 of microphone capsule. Further the
- 35 microphone capsule contains for RF-protection a capacitor C11 connected between the output contacts of microphone capsule. The capacitance of capacitor C11 is

small. Together with the stray inductance of capacitor it causes a series resonance at certain frequency band, which is arranged to including the transmitting band of the mobile phone in question. Then the parallel capacitor C11 attenuates disturbances occurring at said band. The problem here is that the RF protection works only at narrow frequency band. The layout of the microphone components on a circuit board inside capsule has to be done very carefully, and changes in the capacitance values of the capacitors, even changes within production tolerances, may cause the RF protection to shift out from the desired frequency band.

The first protection circuit 110 is connected to first and second output contacts of microphone capsul. The circuit includes in succession from the microphone capsule a series coil L11 at second output contact, a parallel ESD protector VDR1, a series coil L12 at first output contact and a parallel capacitor C12. The capacitor C12 and coil L12 are for filtering disturbances. The ESD protector is in this example a voltage dependent resistor (VDR) or varistor. Its resistance drops shorting the circuit when a electro-static disturbance having relatively high energy arrives along the transmission line 120. The disadvantage of the external varistor is that it has some internal capacitance, which couples with the capacitance of capacitor C11 causing a new resonance. This may lead to RF immunity failures at some frequency band. For this reason there is coil L11, e.g. a ferrite bead, in the protection circuit 110. It weakens said capacitive coupling and corresponding resonance. However the inductance of coil L11 may cause significant resonance at certain other frequencies. It is possible to add a resistor R11, instead of a coil, in series to one output conductor of the microphone capsule, to weaken said capacitive coupling. However such a resistor should be very large to sustain an ESD pulse. Small surface mounted resistors change their resistance and typically fail in ESD tests. Further adding a resistor between the ESD protector and the microphone may cause the microphone more susceptible to ESD.

The second protection circuit 130 at the other end of headset cable is for protecting the actual microphone amplifier 140. The second protection circuit includes a series coil L13 and a parallel circuit forming of a capacitor C13 and a resistor R12 connected in series.

So in conventional design there may be several, up to ten additional components whose purpose is to protect the microphone from ESD and RF disturbances. The immunity to both ESD and RF disturbances is still inadequate. By means of additional components are overcome some problems, but at the same time arise new difficulties. The more components there are in the circuit, the larger are the

conductive loops of circuit and correspondingly the greater the susceptibility to RF-disturbances. Further additional components make new resonance problems.

The object of the invention is to present a microphone structure which is compact, relatively immune to radio frequency disturbances and protected against electro-static discharge.

The basic idea of the invention is as follows: An electro-static discharge protector is placed close to microphone capsule, preferably inside it, between two output conductors of capsule. Parallel with the preamplifier there is a capacitor. Between this capacitor and said ESD-protector is a series resistor. The capacitor, resistor and ESD protector form a low-pass filter protecting the microphone from radio frequency disturbances. The filter structure may include also additional components.

A microphone structure according to the invention comprises a microphone capsule, which has at least first and second output contact, and within said microphone capsule

- means for converting changes in air pressure to an electrical signal,
- preamplifier having first and second output conductor and
- a first capacitor connected between said output conductors of the preamplifier, and is characterized in that it further comprises an electro-static discharge protector connected between said output contacts of microphone capsule and, within the microphone capsule, a first impedance in series between said first output conductor and said first output contact.

The advantage of the invention is that when the ESD protector is placed just close to the microphone capsule or within the microphone capsule, it functions both as an ESD protector and a part of a low-pass filter. Another advantage of the invention is that when the disturbances are filtered within the microphone capsule, the conductive capsule functions as a Faraday cage enhancing the RF-immunity of the microphone. Further advantage of the invention is that the conductive loops of the protective circuit are small making the circuit less susceptible to RF disturbances. A further advantage of the invention is that for the capacitance values are allowed greater tolerances than in known structures. This is caused by the fact that the filter in accordance with the invention attenuates disturbances at wider frequency band than known protective structures inside microphone capsule. A further advantage of the invention is that the internal capacitance of the ESD protector does not form above mentioned problem in RF-immunity. On the contrary the internal capacitance

improves the RF-immunity, because it is a part of said filter. A further advantage of the invention is that the microphone in accordance with it may function as an ESD protector for other components outside the microphone capsule, typically for the input stage of the microphone amplifier. A further advantage of the invention is that the structure according to it is relatively low in production costs because it has several components less than known microphones with external protection circuitry, and all components needed can be mounted on the same circuit board inside microphone capsule.

The invention will now be described more in detail. In the description, reference will be made to the accompanying drawings where

Figure 1 shows an example of microphone circuit diagram according to the prior art,

Figure 2 shows an example of microphone circuit diagram according to the invention,

Figure 3 shows another example of microphone circuit diagram according to the invention,

Figure 4 shows an example of layout of the circuit according to Figure 2,

Figure 5 shows an example of ESD-protection arrangement,

Figure 6 presents measured audio disturbance level at frequency range 0.15-80 MHz for the microphone structure according to Figure 1,

Figure 7 presents measured audio disturbance level at frequency range 0.15-80 MHz for the microphone structure according to invention,

Figure 8 presents measured audio disturbance level at frequency range 80-1000 MHz for the microphone structure according to Figure 1, and

Figure 9 presents measured audio disturbance level at frequency range 80-1000 MHz for the microphone structure according to Figure 2.

Figure 1 was already discussed in connection with the description of the prior art.

Figure 2 presents an example of microphone circuit diagram according to the invention. It comprises a microphone capsule 200 containing an electret microphone M2 and in parallel with it a RF-protection a capacitor C21, as in Figure 1. Further the microphone capsule contains an ESD protector VDR2 and a resistor R21. The ESD protector is between the output contacts of microphone capsul and the resistor

R21 is in series with one output conductor between capacitor C21 and ESD protector VDR2. Said three components form then a  $\Pi$ -structure. The capacitance of ESD protector is now exploited so that the  $\Pi$ -structure functions as a filter having relatively wide rejection band. Outside the microphone capsul are now not  
 5 needed any components. The circuit protects both the microphone M2 and the microphone amplifier 240. Then a separate protection circuit at the input of microphone amplifier is not needed, too.

Figure 3 presents another example of microphone circuit diagram according to the invention. All parts presented are inside a microphone capsule 300. The circuit is a  
 10 ladder structure, which includes in the direction from output contacts OC1 and OC2 of the microphone capsule to the microphone M3 following parts: A parallel ESD-protector ZD, a series impedance Z, a parallel capacitor C33, a series resistor R31, two parallel capacitors C32 and C31, and a microphone M3 comprising a FET Q3. The said structure includes more loops than the structure in Figure 2, in which case  
 15 there are wider possibilities to determine properties of the filter in question. The filter can have yet more loops than presented in Figure 3.

The impedance Z may be mainly resistive or mainly inductive. In latter case it may be e.g. a coil or a ferrite bead. The ESD-protector is in this example a zener diode. It may be also another semiconductor or a polymer component. The polymer  
 20 component means in this description and patent claims a component having small conductive pieces in plastics and controlled breakdown characteristics.

In the example of Figure 3 the structure parts zenerdiode ZD, part Z, capacitor C33, resistor R31, capacitor C32 and capacitor C31 are integrated forming one  
 25 component IC. Because of the loops of the circuit are very small and inside the conductive casing of the capsule they do not impair the susceptibility to RF-disturbances.

Figure 4 presents an example of layout of the circuit according to the invention. In Figure is seen enlarged a circuit board 41, on which there are components connected in accordance with Figure 2. The reference characters, too, are same in  
 30 Figures 4 and 2. Capacitor C21, resistor R21 and varistor VDR2 are chip components in this example. The circuit board 41 is placed inside the microphone capsule 200, an example of which is showed on different scale by the board 41 in Figure 4. Two output contacts OC1 and OC2 are enough in microphone capsule, because of the electret microphone needs, as known, no separate supply voltage. Of  
 35 course into the capsule can be led a separate supply voltage, too.

Figure 5 presents an example of ESD-protector outside the microphone capsule. In Figure can be seen a microphone capsule 500 and first and second output contact OC1, OC2. Further the structure comprises an ESD-protector FTC fastened according to invention on the bottom of microphone capsule. The protector FTC (feed through component) is in this example a cylindrical piece having a hole with conductive surface in the direction of axis, and having conductive sheet which is galvanically connected to the casing of capsule. First output contact extends through said hole. Second output contact is galvanically connected to the casing of capsule.

Figures 6-9 present results of tests, in which to the microphone circuit is supplied modulated high frequency signal. At the poles of microphone is measured, how strong disturbance occurs at frequency 1 kHz. In Figures is marked with horizontal line the boundary of hazardous disturbance (-35 dBpa).

Figure 6 shows the result of known structure according to Figure 1. The measured audio level is presented as a function of high frequency at the range of 150 kHz – 80 MHz. In Figure can be seen that the disturbing level stays below said boundary, but is quite near it at frequency 1,5 MHz.

Figure 7 shows the result when the known microphone capsule is replaced with a microphone capsule according to the invention, Figure 2. The capacitance C2 is 10 pF, the resistance R21 is 47  $\Omega$  and the internal capacitance of varistor VDR2 is 360 pF. In Figure can be seen that the disturbing level stays at whole measuring range very near the noise level about -58 dBpa. When the external components corresponding the circuit 110 in Figure 1 are removed, the result is essentially same as in Figure 7. The better protection is then wholly achieved by the II-type protection circuit inside microphone capsule.

Figure 8 shows the result of known structure according to Figure 1. The measuring frequency range is now 80 MHz – 1GHz. In Figure can be seen that the disturbing level stays below said boundary, but is remarkable high at frequency bands about 200 – 370 MHz and 470 – 520 MHz.

Figure 9 shows the result when the known microphone capsule is replaced with a microphone capsule according to Figure 2 and external protection circuit 110 is removed. Also the protection circuit of microphone amplifier, as circuit 130 in Figure 1, there is not. In Figure can be seen that disturbances are distinctly attenuated at frequency band 200 – 520 MHz compared with Figure 8. At frequency band 80 – 100 MHz the disturbing level has risen.

- Above it is described the basic solution according to the invention and some variants thereof. The invention is not limited to the solutions described. E.g. the microphone may be also some other type as electret microphone. The protection circuit may comprise several ESD-protectors connected e.g. in a star. The invention
- 5      tional idea can be applied in different ways without departing from the scope defined by the independent claim 1.

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## CLAIMS

1. A microphone structure comprising a microphone capsule (200; 300), which has at least first and second output contact, and within said microphone capsule
  - means for converting changes in air pressure to an electrical signal,
- 5    - preamplifier (Q2; Q3) having first and second output conductor and
  - a first capacitor (C21; C31) connected between said output conductors of the preamplifier, **characterized** in that it further comprises at least one electro-static discharge protector (VDR2; ZD) connected between said output contacts of microphone capsule and, within the microphone capsule, a first impedance (R21;
- 10   R31) in series between said first output conductor and said first output contact.
2. A microphone structure according to claim 1, **characterized** in that said electro-static discharge protector is within the microphone capsule.
3. A microphone structure according to claim 1, **characterized** in that said electro-static discharge protector is outside the microphone capsule, close by this.
- 15   4. A microphone structure according to claim 1, **characterized** in that it further comprises at least second impedance (Z) in series with said first impedance and at least second capacitor (C33).
5. A microphone structure according to claim 4, **characterized** in that at least one of said series impedances is resistive.
- 20   6. A microphone structure according to claim 4, **characterized** in that at least one of said series impedances is inductive.
7. A microphone structure according to claim 4, **characterized** in that said capacitors and structure parts having series impedance form a ladder network.
8. A microphone structure according to claims 2 and 4, **characterized** in that the preamplifier, electro-static discharge protector, said series structure parts and said capacitors are on the same circuit board (41).
- 25   9. A microphone structure according to claim 4, **characterized** in that at least some of said electronic structure parts are inside the same integrated circuit (IC).
10. A microphone structure according to claim 1, **characterized** in that the electro-static discharge protector is a varistor (VDR2).
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11. A microphone structure according to claim 1, **characterized** in that the electro-static discharge protector is a semiconductor (ZD).
12. A microphone structure according to claim 1, **characterized** in that the electro-static discharge protector is a polymer component.
- 5 13. A microphone structure according to claim 1, **characterized** in that the electro-static discharge protector is a feed-through component (FTC).
14. A microphone structure according to claim 1 having at least two electro-static discharge protectors, **characterized** in that electro-static discharge protectors form one of following connections: parallel, series, star.

### (57) Abstract

A microphone structure comprising a microphone (M) and an electro-static discharge protector (ZD) placed close to microphone capsule (300), preferably inside it. Further the structure comprises within the microphone capsule an e.g. ladder-type filter having parallel capacitors (C31, C32, C33) and series resistors or coils (R31, Z) protecting the microphone from radio frequency disturbances. Structure parts may be on same circuit board or in same integrated circuit (IC). Structure is less susceptible to RF disturbances than known structures and its production costs are lower.

Fig. 3

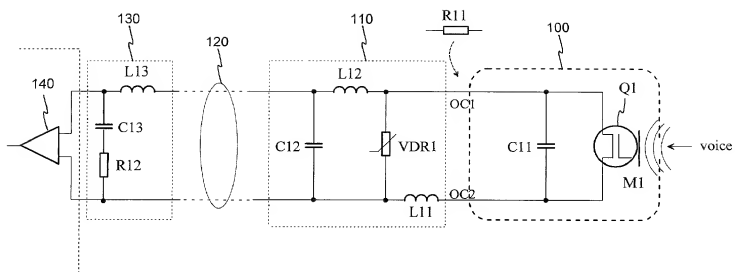


Fig. 1

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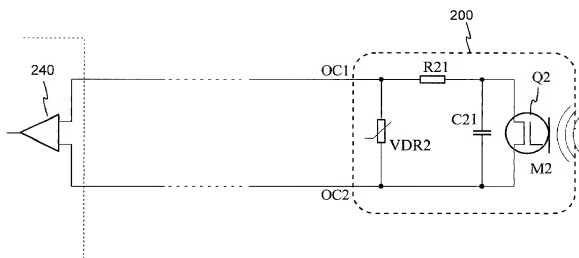


Fig. 2

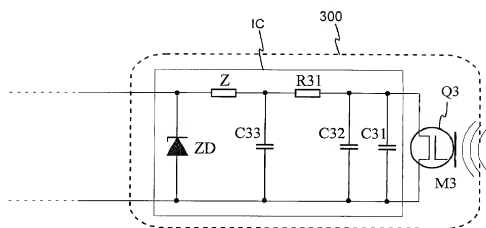


Fig. 3

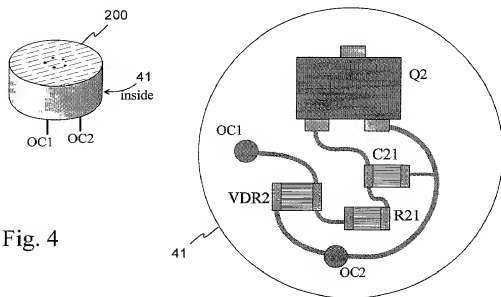


Fig. 4

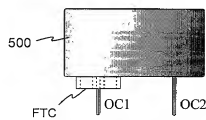


Fig. 5

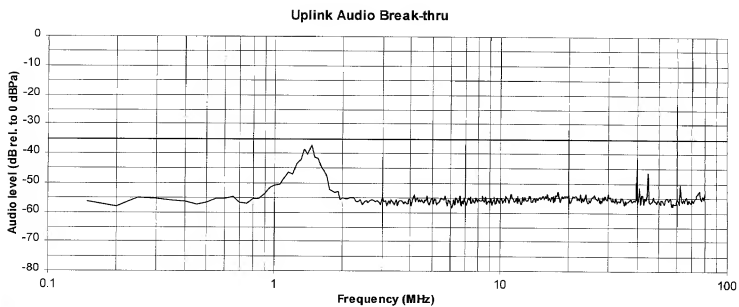


Fig. 6

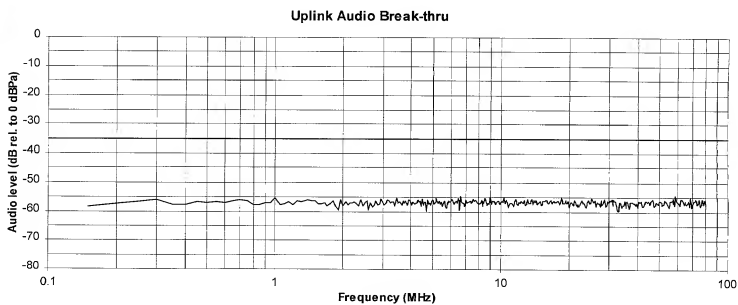


Fig. 7

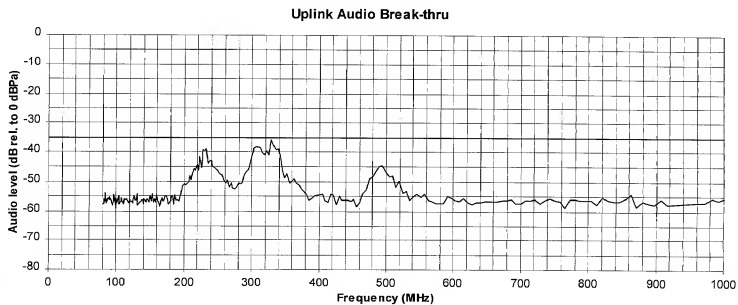


Fig. 8

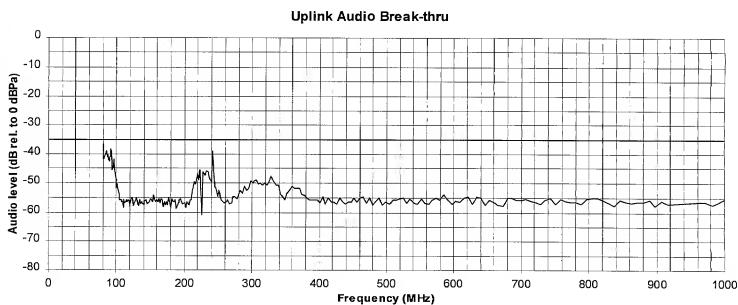


Fig. 9